

Application No. 10/028,437  
Amendment A dated December 8, 2004  
Reply to Office Action mailed June 8, 2004

### AMENDMENTS TO THE CLAIMS

*The listing of claims will replace all prior versions and listings of claims in the application:*

#### Listing of Claims:

1.     **(Original)**     A vertical cavity surface emitting laser for emitting light having a wavelength, comprising:
  - a substrate;
  - an active region adjacent said substrate;
  - a first mirror between said active region and said substrate; and
  - a second mirror adjacent said active region, said active region being between said second mirror and said first mirror; and
  - an ion implanted spatial region that extends into said active region;
  - wherein said second mirror includes an oxide insulating region; and
  - wherein said first mirror and said second mirror are separated by an optical path length of least one wavelength.
2.     **(Original)**     The vertical cavity surface emitting laser of claim 1, wherein said active region has at least one quantum well.
3.     **(Original)**     The vertical cavity surface emitting laser of claim 1, wherein said oxide insulating region and said ion implanted spatial region confine current flow through a center of said ion implanted spatial region.
4.     **(Original)**     The vertical cavity surface emitting laser of claim 1, wherein said ion implanted spatial region is concentrically aligned with said oxide insulating region.

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5. **(Original)** The vertical cavity surface emitting laser of claim 1, wherein said oxide insulating region has an optical path length of less than  $\frac{1}{4}$  wavelength.
6. **(Original)** A vertical cavity surface emitting laser for emitting light having a wavelength, comprising:  
a substrate;  
an active region adjacent said substrate;  
a first mirror between said active region and said substrate; and  
a second mirror adjacent said active region, said active region being between said second mirror and said first mirror, said second mirror including a high aluminum content layer having an aluminum concentration sufficient for oxidizing the second mirror; and  
an ion implanted spatial region that extends into said active region;  
wherein said aluminum content layer is oxidized into an oxide insulating region; and  
wherein said first mirror and said second mirror are separated by an optical path of at least one wavelength.
7. **(Original)** The vertical cavity surface emitting laser of claim 6, further including a first spacer between said first mirror and said active region, and a second spacer between said active region and said second mirror.
8. **(Original)** The vertical cavity surface emitting laser of claim 7, wherein said oxide insulating region extends into said second spacer.
9. **(Original)** The vertical cavity surface emitting laser of claim 6, wherein said substrate is doped with an n-type dopant.
10. **(Original)** The vertical cavity surface emitting laser of claim 6, wherein said active region has at least one quantum well.

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11. **(Original)** The vertical cavity surface emitting laser of claim 6, wherein said oxide insulating region and said ion implanted spatial region confine current flow through a center of said ion implanted spatial region.

12. **(Original)** The vertical cavity surface emitting laser of claim 6, wherein said ion implanted spatial region is concentrically aligned with said oxide insulating region.

13. **(Original)** The vertical cavity surface emitting laser of claim 6, wherein said oxide insulating region has an optical path length of less than  $\frac{1}{4}$  wavelength.

14. **(Withdrawn)** A method of forming a vertical cavity surface emitting laser, comprising:

- forming a first electrical contact on a substrate;
- forming a first mirror structure on the substrate;
- forming a first spacer on the first mirror structure;
- forming an active region on the first mirror structure;
- forming a second spacer on the active region;
- forming a second mirror on the second spacer, wherein the second mirror includes an aluminum content layer having an aluminum concentration sufficient for oxidizing the second mirror;
- forming a conduction layer over the second mirror;
- forming a cap layer over the conduction layer;
- forming a second electrical contact on the cap layer;
- oxidizing the high aluminum content layer to form an oxide layer; and
- ion implanting at least part of the active region under the oxide layer;

wherein the first mirror and the second mirror are at least one wavelength apart along an optical path.

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15. **(Withdrawn)** The method of forming a vertical cavity surface emitting laser according to claim 14, wherein forming the active region produces a quantum well.
16. **(Withdrawn)** The method of forming a vertical cavity surface emitting laser according to claim 14, wherein oxidizing the aluminum content layer produces an annular shaped oxide layer.
17. **(Withdrawn)** The method of forming a vertical cavity surface emitting laser according to claim 14, wherein ion implanting produces non-radiative centers in the active region.
18. **(Withdrawn)** The method of forming a vertical cavity surface emitting laser according to claim 14, wherein forming the second electrical contact includes forming an opening for light emission.
19. **(Withdrawn)** The method of forming a vertical cavity surface emitting laser according to claim 14, wherein the oxide layer is formed less than  $\frac{1}{4}$  wavelength thick.
20. **(Withdrawn)** The method of forming a vertical cavity surface emitting laser according to claim 14, wherein the oxide layer is formed in concentric alignment with implanted ions.
21. **(Withdrawn)** The method of forming a vertical cavity surface emitting laser according to claim 14, wherein the aluminum concentration is above 97%.
22. **(Withdrawn)** The method of forming a vertical cavity surface emitting laser according to claim 14, wherein the first spacer is a lower spacer.

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23. **(Withdrawn)** The method of forming a vertical cavity surface emitting laser according to claim 14, wherein the second spacer is a top spacer.

24. **(Withdrawn)** The vertical cavity surface emitting laser of claim 6, wherein the aluminum concentration is above 97%.